

KSHEERVIDARI (*IPOMOEA DIGITATA L.*) AN UNDERUTILISED MEDICINAL PLANT – AN UPDATE

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ABSTRACT

Ksheervidari is a climber having beautiful pink coloured trumpet shaped flowers and a tuberous root system considered to be medicinal, belongs to the family Convolvulaceae. It has been used by people in various parts of the world for its medicinal as well as nutraceutical potential. It is naturalized in many parts of the world and is cultivated for its tubers and sometimes for its ornamental value. From time immemorial it is being used to cure several body ailments and particularly the tuber powder is consumed in different ways by both men and women as a revitalizer, health promoter, immune booster etc. Besides it is antidiabetic, antihypertensive, galactagogue, antioxidant as well as antimicrobial. Several phytochemicals having pharmacological properties have isolated from this plant. The present study is a review of botanical aspects, pharmacognosy, ethanobotany, cultivation, economics, phytochemistry, medicinal uses and nutraceutical potential.

KEYWORDS: Ethanobotany, Functional, Milk Yam, Phytochemical, Pharmacognosy

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INTRODUCTION

Ksheervidari or Milk yam (*Ipomoea digitata L.*) is an underutilized medicinal plant having therapeutic as well as nutraceutical potential. It is a type of morning glory plant belongs to family of Sweet Potato (Convolvulaceae) having a chromosome number, $2n = 30$ (Plant Resources of Tropical Africa). Its synonyms include *Ipomoea mauritiana* Jacquin., *Ipomoea paniculata* etc. Taxonomically (GBIF, 2013) it belongs to Plantae (Kingdom), Magnoliophyta (Phylum), Magnoliopsida (Class), Solanales (Order), Solanales (Family), *Ipomoea* (Genus) and *digitata* (Species). The other common names are Vidhari Kand, Aligator yam, Giant potato, Finger leaf morning glory, Palmate morning glory etc. In Sanskrit it is called Ikshugandhi, Iksuvalli, Payasvini etc. and in Hindi it is Vidaarikand or Bhukumdaa. The Malayalam names are Palmuthakku, Anchilathaali, Palthookkamkizhangu etc. (www.biodiversityofindia.org, www.keralaplants.in, www.druginfosys.com, www.oshims.com, US National Plant Germplasm System).

Ayurveda Described it in Bhav – Prakash Nighantu as (Mishra, 1969)

विदारी स्वादुकन्दा च सा तु क्रोष्टीसिता स्मृता
इक्षुगन्धा क्षीरवल्ली क्षीरशुक्ला पयस्विनी १८०
विदारी मधुरा स्निग्धा बृंहणी स्तन्यशुक्रदा १८१

Varier (1997) Mentioned this Plant and Its Medicinal Properties as Follows

अन्या क्षीरविदारी स्यादिक्षुगन्धेक्षुवल्ली ।
 इक्षुवल्ली क्षीरकन्दः क्षीरवल्ली पयस्विनी । ।
 क्षीरशुक्ला क्षीरलता पयःकन्दा पयोलता ।
 पयोविदारीका चेति विज्ञेया द्वादशाह्वया । । (राजनिघण्टु)
 रसायनी च वल्या च शीता मूत्रकफप्रदा ।
 स्निग्धा वर्ष्पा गुरुः स्वर्याः पित्तरूग्रक्तदोषहा ॥
 पित्तशूलहरा वातदाहजिन्मूत्रमेहजित् ।
 ज्ञेया कन्दगुणा ह्यस्याः सदृशा वल्लिवद्गुणैः ॥ (निघण्टुर्त्नाकरम्)

According to The Ayurvedic Pharmacopoeia of India (2006) its properties and action are,

Rasa	:	Madhura, Tikta, Kasaya
Guna	:	Guru, Snigdha
Virya	:	Sita
Vipaka	:	Madhura
Karma	:	Brmhana, Balya, Rasayana, Svarya, Vatahara, Vrsya, Varnya, Atimutrala, Stanyajanana, Jivaniya

MORPHOLOGY AND DISTRIBUTION

It is a large, smooth, perennial climber having an elongated and tuberous root system. The leaves are lanceolate, with a heart shaped base and round outline, it is divided palmately into 5 – 7 segments (Kirtikar and Basu, 1987). It flowers during August – September in Kerala conditions and remain open for a short time for the pollinators and insects (www.keralaplants.in). The inflorescence is axillary or terminal cymes having pinkish or reddish purple flowers. The sepals are concave and ovate, corolla is funnel shaped or broadly bell shaped about 35 – 50 x 70 – 80 mm long, having a dark center and enlarged fleshy petals. Staminal filaments are attached to the corolla tube, clothed with hairs on the basal region. Anthers are about 4 mm long. Ovary is rested on a fleshy disc and contain two ovules per locule. Style bears a globular capitate stigma of about 2 mm diameter. It bears fruits during September to December in Kerala (Nair, 2000). Fruits are oval shaped capsules with a persistent calyx at the base (Islam and Bari, 2013). Each fruit contains four black coloured slightly flattened seeds (8 x 6 mm), densely clothed with cottony brown hairs (6 - 8 mm long). Seedling shows epigeal germination. It is from the tenth leaf stage, leaf blade turns palmately lobed and the petioles are deeply channeled containing watery - milky latex. Stem starts twining, tap root starts thickening to a carrot like tuber (Australian Tropical Rainforest Plants).

Its mature tuberous root can be even upto 60 cm long, 30 cm thick, weighing upto 35 kg, from about 5 or 10 kg (Alagumanivasagam *et al.*, 2010). The tubers exhibit annual rings when cut and exudes sticky milky latex (Raut *et al.*, 2011). Ksheeravidari is naturalized in moist tropical regions of India and many other parts of the world (Minaz *et al.*, 2010). In India it is usually found in Bihar, Orissa, West Bengal, Assam and along the western coastal

regions from Konkan to Kerala (www.la-medicca.com/raw-herbs-Ipomoea-digitata.html). In Kerala it is widely distributed in all the districts particularly in low lands and midlands (Nair, 2000). Its leaves, stem and flowers are said to be pharmacologically beneficial but the mature tubers are considered as the ideal officinal part (KAU, 2013).

PHARMACOGNOSY

Tubers of Ksheervidari are 16 – 24 cm long, 8 – 10 cm in breadth, cylindrical to sub – cylindrical or ellipsoid, oblong or globose in outline, having a few thick filial roots, a tapering base and milky latex in it. It has dark brown outer surface with a pale white starchy mass inside (Karthik and Padma, 2009). Khan *et al.* (2009) compared the mature and immature tubers of Ksheervidari and reported, mature tubers are obovoid to sub-cylindrical in shape whereas the immature ones are cylindrical in shape with tapering end. Both the tubers of different maturity possess an outer brownish surface and inner white portion having slightly sweet taste, agreeable odour, mucilagenous with milky latex.

Structural variation between the mature and immature tubers was expressed using transverse section of samples by Khan *et al.* (2009) and reported the presence of large number of growth rings in mature and only one ring in the immature tuber as its difference. Transverse section of tuber is slightly wavy in outline, epidermis not discernable, with 3 to 4 layers of cork cells and 5 to 7 layers of parenchymatous cells. Cork cambium is brown in colour and 2 or 3 cells thick. Endodermis is well developed with a fibrous pericycle followed by 2 layers of stone cells filled with sandy crystals. Phloem is composed of sieve tubes, companion cells, patches of bast fibers and phloem parenchyma. Xylem of young root consists of vessels with scalariform cross perforations, tracheids, xylem fibers and parenchyma. Medullary rays are broad and parenchymatous. Medullar rays and phloem fibers are filled with simple or two to many compound starch grains of 2 – 5 µm in diameter which are polygonal in nature. Hilum and lamellae are indistinct, occasionally a central cleft can be seen (The Ayurvedic Pharmacopoeia of India, 2006).

Longitudinal and transverse sections of Ksheervidari tubers were studied for its laticiferous system and cambial activity respectively by Karthik and Padma (2009). They observed that laticiferous system was differentiated from some of the outer derivatives of vascular cambium and the laticifers are of articulated anastomosing type. This highly branched laticiferous vessel system was developed by joining several very short latex cells with terminal cross walls intact. Transverse section revealed the characteristic bidirectional cortical cambial activity and neither secondary xylem nor secondary phloem had sclereids or fibers.

Transverse section of Ksheervidari tuber was studied by Kuntal Das *et al.* (2015) and reported to contain thin walled cork cells (5 to 8 layers) followed by parenchymatous cells (8 – 10 layers) filled with starch grains with a distinct centric hilum. They reported that its secondary phloem consists of companion cells, sieve tube elements and phloem parenchyma, transversed by uni or biseriate medullary ray. Secondary xylem consists of xylem parenchyma, vessels and fibres.

ETHANOBOTANY

Ksheervidari is using by various parts of the world for its potential pharmacological as well as functional benefits. In Konkan region of India, tubers are washed, peeled, cut into small pieces, dried and powdered, it is then macerated in its own juice and administered with honey and butter for using as an aphrodisiac (www.stuartxchange.com/Aurorang-Gubat.html). Fresh tuber juice combined with cumin, coriander, fenugreek seeds and sugar can also be used as a lactagogue for curing spermatorrhoea (Panda, 1999). Yousuf *et al.* (2009) described its use for treating sexual disabilities

in Khagrachari district of Bangladesh. Kandha tribes of Orissa are using the tuber juice along with cow's milk continuously for seven days to increase lactation (Behera *et al.*, 2006). In Africa also, the root mixed with palm wine for using as a galactagogue [[http://uses.plantnetproject.org/en/Ipomoea_mauritiana_\(PROTA\)](http://uses.plantnetproject.org/en/Ipomoea_mauritiana_(PROTA))].

Also, Ksheervidari powder and barley powder in equal proportions (1: 1) can be mixed with ghee, milk and sugar to prepare a porridge for curing emaciation (KAU, 2013). The root powder, equal parts of wheat flour and barley, milk, ghee, honey and sugar can also be used as a restorative for emaciated and debilitated children (www.stuartxchange.com/Aurorag-Gubat.html).

In Midnapore district of West Bengal its tubers are eaten raw and it is popular for its astringency which is beneficial for treating blood dysentery (Singh and Panda, 2005). In Sreepur Upazilla, Magura district of Bangladesh, folk medicinal practitioners (Kavirajees) are using Ksheervidari for curing diseases as well as a functional food for improving voice and general health of humans (Rahmatullah *et al.*, 2010).

Yaogika chikitsa and *Dravya guna* has mentioned its use for treating hypertension and heart diseases (Sarkar, 1969) also, Ksheervidari tuber powder added with honey can be beneficial for reducing blood pressure and heart diseases. In Gabon, tubers macerated with water are used as a wash against venereal diseases. Tuber macerated along with *Ampelocissus bombycina* is used to treat oedema. Its young shoots are ground and applied to immature gangrenous and necrotic ulcers in DR Congo [[http://uses.plantnetproject.org/en/Ipomoea_mauritiana_\(PROTA\)](http://uses.plantnetproject.org/en/Ipomoea_mauritiana_(PROTA))]. Rahmatullah *et al.* (2014) documented the use of Ksheervidari by a folk medicinal practitioner (Kaviraj) of Pabna district, Bangladesh. Kaviraj recommended a formulation containing tuber of Ksheervidari, bark of *Pterocarpus santalinus*, fruits of *Phyllanthus emblica* and fruits of *Elettaria cardamomum* mixed with ghee and honey taken orally at a rate of 3 g taken for 3-4 times a day for increasing appetite.

Pattali *et al.* (2015) reported that dehumidified air drying method can reduce the moisture content of whole leaf *Aloe vera* slices to 8.57% (dry weight basis) in 11 hours at 55±1°C and 18±1% RH which is faster than open yard sun drying and hot air drying. Solar drying and shade drying of Aonla flakes were done by Kamble and Lavande (2014) and reported that solar drying can reduce drying period by 50 percent compared to conventional shade drying method. Navale *et al.* (2015) made an attempt to evaluate the performance of cabinet solar dryer and open sun drying to dry the fenugreek leaves. They reported that the samples dried in open sun took seven hours whereas those in cabinet solar dryer took only four hours which showed its higher efficiency (68.12%). Senapati *et al.* (2014) reported that Ashwagandha roots dried in micro wave drier contain 1.94% total alkaloids and possess a higher rehydration ratio (4.16) than sun dried samples. Shade drying, sun drying as well as oven drying of lemon grass yield relatively equal quantity of oil but, good quality oil containing the characteristic compound citral or its derivatives can be obtained by shade drying only (Dutta *et al.*, 2014). Influence of different drying methods on pepper mint oil composition was studied by Arab *et al.* (2015) and reported that even though irrespective of the drying methods used, all components are present in the extracts, extracts of shade dried mint leaves contain significantly higher amount of components. Drying methods, temperature and pre-treatment like blanching had a significant effect on ascorbic acid, calcium content, iron content as well as rehydration ratio of curry leaves. Tray drying of blanched curry leaves at 55°C can give good quality dehydrated curry leaves (Kenghe *et al.*, 2015). Irrespective of the drying methods tried all samples of Bush tea (*Athrixia phylicoides*) exhibited antimicrobial activity against both gram - positive and gram – negative microorganisms with a minimum inhibitory concentration (MIC) value ranging from 3.1 to 6.3 (Mudau and Ngezimana, 2014).

ECONOMICS AND CULTIVATION

Milk yam prefers a peat soil, medium to high water content and medium sun shine (Bihrmann's Caudiciforms). Seeds as well as vine cuttings having 1 – 2 nodes is usually used for propagation. Polybags filled with soil, sand and FYM in the ratio of 1: 1: 1: 1 and soil amenders like rice husk and saw dust is effective for rooting 3 noded leafy shoot cuttings (Raut *et al.*, 2011). This can be transplanted to the main field at a spacing of 50 x 50 cm or 60 X 60 cm, after about one month when it generates sufficient root system and vines have to be trailed on a support (KAU, 2013). The plant give an economic yield of tubers by around one and a half to two years after planting (Mathew *et al.*, 2005).

In vitro multiplication, callogenesis and indirect shoot regeneration in *Ipomoea digitata* L. was studied by Islam and Bari (2013) and reported that MS media containing 1.0mg/L BAP and 0.5mg/L IAA can have 95% shoot regeneration and highest number of shoots per culture (6 numbers). Islam *et al.* (2014) had developed a protocol for *in-vitro* callus induction, by culturing young stems in Murashige – Skoog's (MS) medium supplemented with 6 – benzylamino purine (BAP), 2,4- dichlorophenoxyacetic acid (2,4 – D), indole – 3- butyric acid (IBA) etc.

Anilkumar *et al.* (2007) studied the effect of cropping system, organic manure and soil moisture on yield and quality of Ksheervidari along with other medicinal plants needed for the preparation of Sathavarigulam was carried out in the Instructional Farm, College of Agriculture, Vellayani, Kerala Agricultural University, Thrissur, India. The study found that mixed cropping of milk yam with other component crops of Sathavarigulam like, *Asparagus racemosus*, *Zingiber officinale*, *Piper longum*, *Tribulus terrestris*, *Curculigo orchoides*, *Cyclea pelteta*, *Hemidesmus idicus* in the inter spaces of coconut garden integrated with farm yard manure application @ 20 t/ha/year under irrigated situation can give good tuber yield and high benefit: cost (BC) ratio.

The tuberous roots harvested have to be cut into small pieces, sun dried and again, dried in an oven at reduced temperature ($\leq 50^{\circ}\text{C}$) (Khan and Hossain, 2015) before storage. For preparing edible Ksheervidari powder, harvested mature tuber can be washed, peeled and shredded into small pieces. Wash it again for atleast three times in good quality running water, drain the excess water by keeping it in a bamboo basket for sufficient period of time. It can be dried in a hot air oven maintained at 60°C for 12 hours. The dried tuber can be milled and the prepared powder would have high nutritional value (per 100g) – protein (12.58g), total carbohydrate (24.36g), soluble carbohydrate (4.78g), fat (1.28g), fibre (7.2g), ash (5.23g) and vitamin C (68.35 mg/g) (Sonia and Jessykutty, 2016).

Ksheervidari is commercially cultivating by marginal land holders of villages in Natore district of West Bangladesh in a very small area of 0.9 acres where a primary producer is getting 10 Taka (Tk) /kg for the tubers (Shahidullah and Haque, 2010). In Kerala, mature tubers are sold at a rate of R5. 5.00 (per kilogram) by the Kerala State SC & ST Federation during 1996 – '97 (Nair, 2000). In Thiruvananthapuram district of Kerala, price spread of the tubers accounted to be 316.67% increase from medicinal plant collection agents to the consumers (Menon, Parvathi, 2003). Approximate annual requirement of milk yam tubers is around 2360 tonnes in 1976 and it is reduced to 425 tonnes by 1986 (Unnikrishnan, 2004).

Milk yam is often grown for ornamental purposes by training against trellises and pillars (Australian Tropical Rainforest Plants) for its beautiful pink or purple flowers and shade. The stem and leaves of the plants are used as fodder (Nair, 2000). In India and Senegal (Africa) the plant is browsed or feed to the cattle for enhanced milk production [[http://uses.plantnetproject.org/en/Ipomoea_mauritiana_\(PROTA\)](http://uses.plantnetproject.org/en/Ipomoea_mauritiana_(PROTA))].

PHYTOCHEMISTRY

Phytochemical components present in Ksheervidari had explored by different scientists using different analytical methods are reviewed here. In 1964 itself Mishra *et al.* reported that Ksheervidari tuber contain 1.3% fixed oil which contain oleic acid (60.1%), linoleic acid (19.38%), palmitic acid (8.15%), and linolenic acid (1.11%) in mixed acid fraction. Karthik and Padma (2009) reported that methanol and water extracts contain alkaloids, glycosides, phytosterols, flavonoids, proteins, gums and mucilage, whereas, fats, oils and resins are in petroleum ether and chloroform extracts. Also, carbohydrate is present in all the extracts obtained from petroleum ether, hexane, ethylacetate, chloroform, methanol and water. Investigation on phytochemical constituents present in Ksheervidari tubers by Monjur – Al – Hossain *et al.* (2013) also ensured the presence of constituents like alkaloids, tannins, steroids, gums, glycosides, carbohydrates and saponins. The presence of sterols, resins, glycosides and flavonoids in alcoholic and aqueous extracts was reported by Minaz *et al.* (2010). Ksheervidari tuber extracted using acetone contain higher quantity of phenols (285.05 mg gallic acid equivalents (GAE) /g extract), tannins (190.02 mg GAE/g extract) and flavonoids (174.44 mg rutin equivalents (RE) /g extract) among the different solvents studied (petroleum ether, chloroform, acetone, methanol and hot water) (Viji and Paulsamy, 2016).

Thin Layer Chromatography (TLC) of Ksheervidari's methanolic extract showed 7 different spots at Rf 0.19 (green), 0.34 (magenta), 0.45 (green), 0.48 (blue), 0.62 (blue), 0.67 (red) and 0.92 (dark pink) (The Ayurvedic Pharmacopoeia of India, 2006). Ksheervidari contain taraxerol, taraxerolacetate, β – sitosterol, scopoletin and 7 – O – β – D – glycopyranosyl scopoletin (Scopolin) (Sharma *et al.*, 1972). Triterpenid, coumarin, octadecyl ϵ – p – coumarate, t – cinnamic acid [undecyl ϵ -3 -(4 – hydroxyphenyl)-2-propenoate], an unknown coumarin (5 – hydroxyl – 7 – ethoxy coumarin) and a lignin type resin glycoside also present in the tubers (Rao, *et al.*, 1984; Hao – Fu *et al.*, 2000; Madhavi *et al.*, 2010). Ono *et al.* (2009) reported the presence of isobutyric, (S)-2-Methylbutyric, Tiglic, n-decanoic, n-dodecanoic cinnamic acids and two glycosidic acids – Quamoclic acid A and Operculinic acid – A. A resin glycoside 'digitajalpin' was extracted and its structure were also determined on the basis of H – NMR and C – NMR spectral data.

Khan *et al.* (2009) compared phytoconstituents and bioactivities of immature tubers with mature tubers. Qualitative evaluation of both mature and immature tubers revealed the presence of alkaloids, carbohydrates, glycosides, saponins, phytosterols, resins, flavonoids and proteins. Immature tubers contain more proteins and saponins (6.60% and 7.28%) than the mature tubers (4.4% and 1.65%) whereas mature tubers (5.80%) contain more starch than the immature ones (2.10%). HPLC and HPTLC analysis of these tubers also supported the finding that there exists a variation in the phytoconstituents among immature and mature tubers, the mature ones contain more phytoconstituents than the immature ones.

The amount of Umbelliferone, another important phytoconstituent which is an anti – coagulant and anti – HIV in action (Meira *et al.*, 2012) was quantified using HPLC and HPTLC as 97.90% and 98.90% respectively (Dighe and Adhyapak, 2011). HPLC and HPTLC had same efficiency and sensitivity in determining umbelliferone from dried tuber powder. Ethyl acetate: methanol: water: ammonia (13: 5: 1.8: 0.2) solvent system was used to isolate and quantify scopoletin in the methanolic extract of Ksheervidari tubers by Karthik and Padma (2009). TLC finger print of the methanolic extract revealed the presence of Scopoletin (Rf value 0.56) and it is quantified to be 0.029 – 0.034% using HPLC and HPTLC methods. Scopoletin and β – sitosterol glucoside, an antioxidant were isolated from its ethanolic

extracts and also able to elucidate its structure using H - NMR and C - NMR spectroscopic analysis Khan and Hossain (2015). Ashajyothi and Satyavathi (2016) has confirmed the presence of alkyne, alkane and C – F bond in ethanolic Ksheervidari extract using FT – IR analysis.

Viji and Paulsamy (2016) had done the GC – MS profiling of Ksheervidari's acetone extract and revealed the presence of 27 compounds. The highest peak area (14.22%) is observed for hexadecanoic acid (palmitic acid). The phytochemicals present in the plant make it as a phytoestrogen source since its activity is similar to estrogen present in human body which justifies its use in curing ailments related to female reproductive system (Ashajyothi *et al.*, 2013).

MEDICINAL USES

Therapeutic activity of Ksheervidari against a wide array of human disorders has been reviewed here. Administration of hydroalcoholic Ksheervidari extract at a dose of 100 – 200 mg/kg body weight for 28 days showed significant antidiabetic activity (Pandey *et al.*, 2013). Anti - diabetic activity of hydro-ethanolic Ksheervidari extracts in alloxan induced diabetic rats when studied by Minaz *et al.* (2010) revealed that both alcoholic and aqueous extracts have antidiabetic activity. Chandira and Jayakar (2010) had formulated anti – diabetic herbal tablets using aqueous Ksheervidari extract. Its administration at a dose of 300 mg/kg body weight in streptozotocin induced diabetic rats could significantly decrease the blood glucose level.

Administration of Ksheervidari tuber powder (3g) for a period of 12 weeks had potent antihypertensive properties for individuals having stage I hypertension Jain *et al.* (2011). A similar report was given by Haider (2013). Administering methanolic Ksheervidari tuber extract at a rate of 300mg/kg could significantly reduce the cholesterol in hyperlipidemic rats (Muthu *et al.*, 2011). A herbo - mineral drug containing Ksheervidari, when evaluated for its clinical efficacy by Rani *et al.* (1997) proved its revitalizing effect since, an overall improvement ranged between 69 – 77% was reported in all the patients having symptomatology of general weakness, appetite, sleeplessness etc. Crude ethanolic Ksheervidari extracts have analgesic activity also as reported by Monjur – Al – Hossain *et al.* (2013).

Ksheervidari at a rate of 250 – 500 mg/kg body weight for 40 days is reported to be effective against male infertility since a significantly high sperm density was recorded in neem oil induced infertile albino rats by Mahajan *et al.* (2015). For females, Ksheervidari is supposed to be a galactagogue. A lactogenic polyherbal formulation named 'Lactovedic' containing Ksheervidari when administered to rats having suckling pups exhibited a significant galactagogue activity (Meera and Narasimhulu, 2011). Ksheervidari can be a good immuno-modulatory also. Ksheervidari when tested by carbon clearance test on wister rats by Kuntal Das *et al.* (2015) revealed its close activity to *Withania somnifera* powder, an approved potent immunoglobulatory agent.

Several studies proved its antioxidant activity also. Vasagam *et al.* (2010) reported that Ksheervidari tuber had 230 µg/ml hydroxyl radical scavenging activity, 800 µg/ml by FRAP method and 7.51mg/g total phenol content. Monjur – Al – Hossain *et al.* (2013) reported 164 µg/ml DPPH free radical scavenging activity for the tuber extract. According to Shakhawat *et al.* (2015) Ksheervidari had only moderate antioxidant activity when compared with other medicinal plants. Alagumanivasagam *et al.* (2010) could report an increased level of antioxidant enzymes like superoxide dismutase, catalase, glutathione peroxidase and glutathione reductase in high fat diet rats administered with Ksheervidari.

Ksheervidari possess antimicrobial activity and hence using against skin infections, body malodour right from the ancient times itself (Jain, 1991). An unknown coumarin present in the tubers showed antibacterial activity against

Psuedomonas aeruginosa and *E. coli* (Madhavi *et al.*, 2010). Mahendra *et al.* (2015) had found out antimicrobial activity of Ksheervidari extracts (petroleum ether, chloroform, ethyl acetate and methanol) against skin pathogens like *Malassezia furfur*, *Propionibacterium acnes* and *Corynebacterium diphtheria* (@ 1, 20 and 50 mg/ml). Viji and Paulsamy (2016) found out different compounds having specific antimicrobial properties like, tetradecanal, E-15-Heptadecenal, Octadecanoic acid and 1- Docosanol methyl ether. Hexadecanoic acid and Hexadecan – 1 –ol trans -9 are the compounds with anti-inflammatory activities in milk yam tubers as reported by Viji and Paulsamy (2016).

NUTRACEUTICAL POTENTIAL

Ksheervidari has tremendous potential as a nutraceutical agent but still remains as an underutilized medicinal plant (Sonia and Jessykutty, 2016). The tubers are rich in carbohydrate, starch, protein, vitamins etc. The leaves contain carotene at a rate of 6.3 mg/ 100g (Nair, 2000). Proximate composition of mature and immature tubers of Ksheervidari were compared by Khan *et al.* (2009). Kuntal Das *et al.* (2015) compared the nutritional composition of Ksheervidari with other Vidari drug sources like *Peuraria tuberosa*, *Adenia hondala* and *Cycas circinalis*.

Ksheervidari is a component of popular Ayurvedic nutraceutical products like Chavanaprasha, Aswagandharistam, Balarishtam and Dhanwantharishtam (Venkatasubhramanian *et al.*, 2009). According to the Ayurvedic Pharmacopoeia of India (2006) an important formulation containing Ksheervidari is Sivagutika and the recommended dosage is 5 – 10g. It is also an important constituent in Ayurvedic formulations like Vidaryadikvatha Churna, Vidaryadi Ghrita, Marma Gutika, Manmathabhra Rasa, Pugakhanda (Aparah), and also in Dasamoolarishtam and Chavanaprasam (KAU, 2013). The other formulations containing Ksheervidari are Vidaryadi Gritha, Vidaryadi Kasaya, Vidaryadi Leha, Phala Ghrita etc. Mahamash oil is a Ksheervidari product of Vasu Research Center, a division of Vasu Healthcare, Pvt. Ltd., Vadodara, Gujarat, India. Sathavarigulam containing Ksheervidari is recommended at a rate of 10 g twice daily with milk. Marmagulika is also a capsule recommended at a dose of ½ to 1 tab thrice daily with milk or jeeraka (cumin) water for curing leucorrhoea, body pain due to trauma and burning micturition. Ayu Muscle Tone is an ayurvedic muscle tablet containing Ksheervidari along with different medicinal plants recommended as a bone and muscular tonic consumed at a dose of two tablets twice a day.

A herbo-mineral drug namely Revivin is evaluated for its clinical efficiency and safety by Rani *et al.* (1997) and reported it as a potential revitalizer which showed an overall improvement of 69 – 77% for patients having various symptomatology of general weakness, appetite, sleep mood and lack of concentration. National R & D facility for Rasayana (FRLHT) recommended the consumption of Vidari Kalka (paste), 10g dissolved in half glass of milk twice daily as a revitalizer (Pandey and Tripathi, 2010).

Ksheervidari is beneficial for both men and women as it supports fertility and vitality. Vidari tuber juice (25ml) or Vidari powder (10g) added to milk and consuming thrice daily after food could act as a galactagogue (Bhatt *et al.*, 2009). For increased sperm production vidari juice/ powder (10g) mixed with 5g ghee and 25 milk can be consumed thrice daily after food for two months is beneficial. *Ipomoea digitata* is a major ingredient in various mixtures used as nutritive, diuretic and expectorants (Iyer, 1962). Today different companies like, Satveda (herbs forever since 1932) is selling Vidari kanda powder, a micronised powder potentiated with Vidari's decoction as a dietary supplement with different therapeutic claims for men it helps in healthy semen production and in females it helps in healthy menstruation and lactation. Lukowin tablets another product, contain 80 mg Ksheervidari is recommended at a dose of 2 tablets with water daily for curing menstrual disorders (www.indiamart.com). Hamdard laboratories, Pakistan also selling milk yam products in the brand

names, Habb – e – Asgand and Sharbat Mufarreh Muqawwi – e – Qalb (www.druginfosys.com).

CONCLUSIONS

Ksheervidari is a potential medicinal as well as nutraceutical agent. The plant usually naturalized in moist tropical regions sometime as a weed can be cultivated easily with minimum inputs. It has been proved with several medicinal uses and found beneficial for curing a wide array of disorders. Pharmacognosy of the tubers are studied thoroughly which helps in the standardization of crude drugs and preventing possible adulteration. Research has been ignited also on the isolation and quantification of phytochemicals as well as its therapeutic activities through *invitro* and *invivo* clinical trials. Inshort, research has be oriented towards improving the status of Ksheervidari from an underutilized medicinal plant to a potentially useful one since, it has got several medicinal and functional benefits which could help in improving the overall wellbeing of human beings.

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